

Comparison of Body Measurements between Korean and the U. S. Women Aged Over 55

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Abstract

Anthropometric studies and multicultural research on body changes are fundamental and important data for domestic apparel industry and for globalization of women's clothing marketing. The objective of this study is to compare the general body measurements and shoulder angles of Korean and U. S. elderly women to supply basic data for the apparel design. The anthropometric data was collected including both direct and indirect measurements of 272 women over the age of 55 in Korean (subject = 123) and the U.S (subject = 149). The statistical methods used for the analysis of measurement data are the factor and cluster analysis respectively. The results of the factor analysis indicated that 5 factors can be extracted in Korean and 4 factors can be extracted in the U. S. from 15 body measurements to explain the variance. The results of cluster analysis by shoulder slope angle and forward displacement of the shoulder of Korean and the U. S. women classified them in three groups, cluster 1, cluster 2 and cluster 3 respectively.

Key words: anthropometric, body measurement, cluster analysis, factor analysis

I. Introduction

With the recent increase in globalization, multicultural aspects of marketing and production become important for the exchange of apparel¹⁾. With the globalization of marketing, anthropometric studies and multicultural research into consumer's attitudes and behaviors are being actively conducted in academic institutions. According to the Korean Society for Clothing Industry²⁾, Korean apparel companies export apparel to the U.S. including both formal and casual wear. Compared to the exports of 1999,

those of 2000 increased by 7.4% and this trend continues to increase every year.

For the export of Korean and American apparel manufacture, therefore, the comparison and analysis of consumer's measurements and somatotypes according to gender, age, race and period are meaningful research.

Well-fitted clothing is important to an individual's psychological and social well-being³⁾⁻⁵⁾, and yet it is difficult for older women to find well-fitting clothing⁶⁾. Goldsberry⁷⁾ interviewed 6,465 women over the age of fifty-five, and concluded that 77% were dissatisfied with the fit

of ready-to-wear apparel. This dissatisfaction can be due to lack of skillfully made patterns that are based on the distinct body type of the older woman. Given 3-D body shapes that vary in size and shape, different results in flat pattern shapes can occur based on very small differences in the body shapes from the point of view of apparel design⁹⁾. Research on body changes that occur with age are fundamental and important data for domestic apparel industry production and for globalization of women's clothing in the world⁹⁾. Nam & Lee¹⁰⁾ examined the differences of perceived body size and actual body size between Korean and USA female college students. Lee, Rudd, & Kim¹¹⁾ studied on body image by comparison of ideal beauty, body image and appearance management behaviors among Korean and American women. Also Beak & Hwang¹²⁾ investigated on the price and objective quality of apparel products between Korean and the United States. These studies addressed body images based on cultural ideals of beauty for young women and the apparel price and quality; no studies on body measurements focused on shoulder angles of women aged fifty-five and older. Therefore, the objective of this study is to compare the general body measurements and shoulder angles of Korean and U. S. elderly women to supply basic data for the apparel design.

II. Methods

1. Data collection

Subjects measured for this study included 123 women in the area of Kwangju, Chonnam and 149 women in the U. S. over the age of 55. The

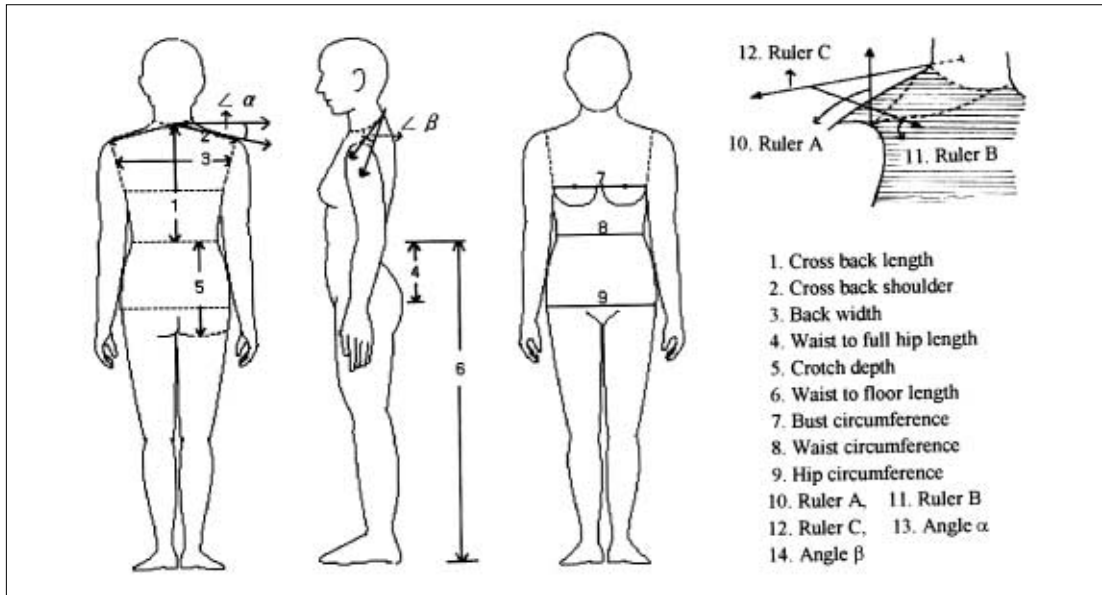
period of data collection was 2000, June to October. Cornell University, the University of Colorado, the University of Minnesota, and the University of California at Davis research groups took the measurement data for the U.S women from 149 Caucasian subjects.

2. Measuring methods and procedures

The anthropometric data was collected including both direct and indirect measurements of 272 women over the age of 55 in Korean (subject = 123) and the U.S (subject = 149). A total sixteen body measurements (3 circumference, 3 length, 2 depth, 4 width, 2 calculated items, 2 angles) were taken on each women. The measured items and calculated items are shown in <Figure 1>. Direct and indirect measurements were taken using R. Martin measuring tools. Angle measurements were calculated from linear measurements taken using a device designed at Cornell that measured the distance of the acromion from the cervicale in the horizontal direction (Ruler C), the vertical direction (Ruler A), and the forward direction (Ruler B).

3. Statistical methods

The statistical methods used for the analysis of measurement data are the factor and cluster analysis respectively. The analysis of variance and Duncan test is used to clarify the characteristics of each somatotype. T-tests are used to compare mean differences between the Korean measurements and the American ones. Factor analysis using principal component analysis is performed by Varimax to clarify the factors. The number of factors is decided based



<Figure 1> Measured items

on an eigen value which is over 1.00 and does not exceed 25% of the total variance. After researching anthropometric characteristics between Korean and the U.S. using factor analysis, the cluster analysis is performed to classify subjects by shoulder shape. The method of cluster analysis is hierarchical cluster analysis using Ward's minimum variance. The number of clusters was decided by root-mean-square standard deviation, semi-partial R-squared, distance between two clusters.

In analyzing the data of the present study, the factor analysis was utilized to extract the common factor among the different variables, and the cluster analysis was also introduced to establish the relationship between the common factors obtained from the factor analysis, and to clarify their characteristics¹³⁾.

III. Results and Discussion

1. Comparison of anthropometric data between Korean and U. S. Women

<Table 1> depicts the means and standard deviations for body measurements of women over the age of 55 in Korean and the U.S. women. T-tests comparing body measurements between Korean and U.S women data found significant differences ($p \leq .001$) exist between center back length, back width, waist to hip length, waist to floor length, bust circumference, hip circumference, ruler A & B, horizontal of shoulder and the forward angle of the shoulder (angle β). There is no significant difference in waist circumference and crotch depth. For the forward angle of the shoulder, angle β the Korean mean is 15.31 and the U. S. mean is 23.34. This value shows that the U.S. women have a stronger

<Table 1> Comparison of antropometric data between Korean and the U. S.

(Unit: cm)

Items	Korea		U.S.A		T-value
	M	SD	M	SD	
1. Center Back Length	38.53	2.33	40.84	2.83	-8.64***
2. Cross Back Shoulders	39.39	2.12	40.36	3.14	-2.14*
3. Back Width	34.30	2.72	38.45	3.62	-5.59***
4. Waist to Hip Length	19.35	2.48	16.27	3.92	3.99***
5. Crotch Depth	24.73	2.24	25.32	2.38	0.96
6. Waist to Floor Length	93.45	4.05	100.26	11.08	-4.83***
7. Bust Circumference	95.46	6.14	99.52	11.79	-3.52***
8. Waist Circumference	84.30	7.06	83.46	13.13	-0.55
9. Hip Circumference	98.22	5.93	104.51	9.14	-7.22***
10. Ruler A	6.50	1.15	5.86	1.86	3.57***
11. Ruler B	4.92	0.99	6.85	1.88	-7.94***
12. Ruler C	18.53	1.38	17.99	1.59	3.16**
13. Horizontal of Shoulder	37.06	2.77	34.18	3.18	-3.72***
14. Drop Value ^a	2.76	4.13	4.99	10.22	-2.47*
15. Shoulder Slope (Angle α)	20.25	4.00	19.92	7.11	2.01*
16. Forward lean of shoulder (Angle β)	15.31	3.29	23.34	7.24	-7.86***

* $p \leq .05$ ** $p \leq .01$ *** $p \leq .001$ ^a Difference between hip circumference and bust circumference

forward dropping shoulder angle than Korean women. For the slope of the shoulder, angle α , Korean women's shoulder slopes shows more slope than the U. S. women, but the significance of this difference is less ($p \leq .05$).

2. Factor analysis

<Table 2> and <Table 3> show the results of factor analysis for Korean and U.S. women respectively. To clarify the body characteristics, factor analysis was performed using the mean of measurements. For Korean women, the result of factor analysis indicated that of 5 factors extracted from 12 body measurements, these factors account for 76.1% of the total variance.

The first factor with a 3.96 eigen value explains

26.41% of the total variance related to the torso. It shows a highly positive value for the waist, the bust and the hip circumference. The second factor with a 2.51 eigen value explains 16.76% of the total variance related to the shape of shoulders. It shows a highly positive value for the horizontal of shoulders, Ruler C, cross-back shoulder, cross-back length. The third factor with a 2.29 eigen value explains 15.28% of the total variance related to the shoulder slope. It explains in highly positive value for angle α and the Ruler A. The fourth factor with a 1.44 eigen value explains 9.62% of the total variance related to the shoulder leaning. The fifth factor with a 1.21 eigen value explains 8.05% of the total variance related to lower body's length and back width.

For the U.S. women, 4 factors are derived from

<Table 2> Factor analysis of Korean women's measurements

Items	Factor	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Contents of factors
Waist Circumference		0.93	-0.05	-0.08	0.07	-0.03	Size of torso
Bust Circumference		0.91	0.19	-0.02	0.09	0.13	
Hip Circumference		0.79	0.32	-0.16	0.15	0.03	
Horizontal of Shoulder		0.09	0.95	-0.05	-0.11	0.07	Shape of shoulders
Ruler C		0.09	0.95	-0.05	-0.11	0.07	
Cross Back Shoulders		0.41	0.46	0.38	0.14	0.32	
Center Back Length		0.25	0.40	-0.19	0.06	0.24	
Ruler A		-0.09	0.08	0.96	-0.10	0.02	Shoulder slope
Angle α		-0.13	-0.25	0.92	-0.05	-0.01	
Ruler B		0.16	0.06	-0.07	0.97	0.02	Shoulder leaning
Angle β		0.12	-0.02	-0.05	0.95	0.03	
Crotch Depth		0.04	-0.01	0.13	-0.08	0.76	Lower body's length and back width
Waist to Floor Length		0.08	0.32	-0.26	-0.09	0.61	
Waist to Hip Length		-0.07	0.21	-0.03	0.21	0.57	
Back width		0.41	-0.21	0.35	0.05	0.54	
Eigen Value		3.96	2.51	2.29	1.44	1.21	
Contribute Ratio of Variance(%)		26.41	16.76	15.28	9.62	8.05	
Cumulative Contribution Ratio(%)		26.41	43.17	58.45	68.07	76.12	

<Table 3> Factor analysis of the U.S. women's measurements

Items	Factor	Factor 1	Factor 2	Factor 3	Factor 4	Contents of factors
Horizontal of Shoulders		0.93	0.18	0.10	0.01	Shape of shoulders
Angle β		0.86	0.04	-0.02	-0.02	
Shoulder Length		0.78	0.37	0.19	-0.02	
Angle α		0.76	-0.04	0.04	0.29	
Hip Circumference		0.02	0.84	0.09	0.04	Size of torso
Bust Circumference		0.12	0.81	-0.08	-0.10	
Back width		0.21	0.80	-0.01	0.24	
Waist Circumference		0.07	0.75	-0.16	0.10	
Waist to Hip Length		0.10	-0.04	0.75	0.09	Lower body's back length
Waist to Floor Length		0.13	-0.14	0.66	0.03	
Crotch Depth		-0.315	0.32	0.55	-0.44	
Center Back Length		0.06	0.24	0.10	0.90	Upper body's length
Eigen Value		3.72	2.28	1.41	1.02	
Contribute Ratio of Variance (%)		31.06	19.02	11.72	8.51	
Cumulative Contribution Ratio (%)		31.06	50.08	61.80	70.31	

the measurements. These factors comprised 70.31% of the total variance. The first factor with a 3.72 eigen value explains 31.06% of the total variance related to shoulder shape. It shows a highly positive value in the value of difference, angle α , angle β , the value of difference between cross back shoulder and horizontal shoulder width. The second factor with a 2.28 eigen value explains 19.02% of the total variance related to torso size. It shows the highly positive value in the back width, the hip, bust and waist circumference. The third factor with a 1.41 eigen value explains 11.72% of the total variance related to lower body shape. It shows a highly positive value in waist to hip length, waist to floor length, crotch depth. The fourth factor with a 1.02 eigen value explains 8.51% of the total variance related to the center back length.

3. Cluster Analysis

When the Korean and the U. S. women body measurements are compared, three kinds of body types with substantial differences were found. <Table 4> and <Table 5> show the results of cluster analysis of the Korean and U.S women respectively. Sorting by the degree of shoulder slope and the degree of forward shoulder drop, the, Korean subjects are classified in three groups of cluster 1, cluster 2, and cluster 3. For cluster 1, the mean value of Ruler C is 18.68, cross back shoulder of cluster 1 is 39.92 showing that this group has a relatively narrow cross back shoulder. Angle α for this group is 21.41, and angle β is 13.14. The characteristic shoulder shape of cluster 1 is relatively straight, square shoulder.

Cluster 2 is the middle group of clusters as

ruler C is 17.38 and cross back shoulder is 39.84. The characteristic of cluster 2 is a relatively forward dropping shoulder shape with an angle α of 23.76 and angle β of 20.66. Cluster 3 has a relatively wide shoulder as ruler C is 18.9 and cross back shoulder 39.12.

The characteristic shoulder shape of cluster 3 is a relatively forward dropping but square shoulder with an angle α of 15.91 and angle β of 17.33.

In case of the U. S. women, cluster 1 is the largest group. For this group Ruler C is 17.35 and the cross back shoulder is 38.68. Angle α is 18.11 and angle β is 19.91. The characteristic of cluster 1 is a relatively upright shoulder shape and narrower shoulder than the other clusters.

The characteristic of cluster 2 reveals a small shoulder slope angle, which results in an almost horizontal shoulder shape and a wide cross back shoulder. The Ruler C value is 17.29 and cross back shoulder value is 44.1. Angle α is 14.59. Therefore, cluster 2 is the middle group among three clusters.

Ruler C of cluster 3 is 15.66, the cross back shoulder measurement is 48.32 and angle β is 35.77. The characteristic of cluster 3 is upright but sloping shoulder that is relatively wide.

IV. Conclusions

The objective of this study was to research data consisting of linear measurements, shoulder angles, and general body types of Korean and U.S elderly women to describe fundamental anthropometric data for the apparel industry. The anthropometric data includes both direct and indirect measurements of 272 women over the age of 55 in Korea and the U.S. for comparison.

<Table 4> Cluster analysis of Korean women

(Unit: cm)

Items	Cluster	M	Cluster1 (n=72)	Cluster2 (n=15)	Cluster3 (n=35)	F-value
1. Center Back Length	M	38.49	38.30	37.50	39.31	4.05*
	G		AB	B	A	
2. Cross Back Shoulders	M	39.38	39.42	39.84	39.12	0.62
	G		A	A	A	
3. Back Width	M	34.30	34.33	35.53	33.71	2.39
	G		AB	A	B	
4. Waist to Hip Length	M	19.32	19.12	19.30	19.76	0.79
	G		A	A	A	
5. Crotch Depth	M	24.71	24.78	24.83	24.52	0.17
	G		A	A	A	
6. Waist to Floor Length	M	93.44	93.37	90.85	94.72	5.11**
	G		A	B	A	
7. Bust Circumference	M	95.50	94.45	95.56	97.64	3.30*
	G		A	A	A	
8. Waist Circumference	M	84.33	82.95	85.16	86.81	3.80*
	G		A	A	A	
9. Hip Circumference	M	98.22	97.35	95.90	101.00	6.19**
	G		B	B	A	
10. Ruler A	M	6.49	6.96	7.20	5.23	57.91***
	G		A	A	B	
11. Ruler B	M	4.92	4.27	6.26	5.70	110.34***
	G		C	A	B	
12. Ruler C	M	18.58	18.68	17.38	18.90	9.58***
	G		A	B	A	
13. Horizontal of Shoulder	M	37.17	37.36	34.77	37.80	9.58***
	G		A	B	A	
14. Angle α	M	20.12	21.41	23.76	15.91	71.93***
	G		B	A	C	
15. Angle β	M	15.27	13.14	20.66	17.33	139.23***
	G		C	A	B	

* $p \leq .05$ ** $p \leq .01$ *** $p \leq .001$

Alphabets were results of Duncan grouping (A>B>C)

The T-test comparing of body measurements between Korean and the U.S women showed significant differences ($p \leq .001$) among center back length, back width, waist to hip length, waist

to floor length, bust and hip circumference, Ruler A, B, C, and forward angle of the shoulder.

To clarify body characteristics, factor analysis was performed of the measurements. The results

<Table 5> Cluster analysis of U.S. women

(Unit: cm)

Items	Cluster	M	Cluster1 (n=110)	Cluster2 (n=17)	Cluster3 (n=22)	F-value
1. Center Back Length	M	40.84	40.62	40.42	42.25	3.35*
	G		B	B	A	
2. Cross Back Shoulders	M	40.72	38.68	44.1	44.1	35.92***
	G		C	B	A	
3. Back Width	M	38.45	38.08	39.36	39.59	2.25
	G		A	A	A	
4. Waist to Hip Length	M	16.27	14.77	17.54	17.77	3.52*
	G		A	A	A	
5. Crotch Depth	M	25.32	25.70	25.25	23.43	9.27***
	G		A	A	B	
6. Waist to Floor Length	M	100.26	100.19	98.31	102.09	0.56
	G		A	A	A	
7. Bust Circumference	M	99.52	98.56	104.41	100.52	1.92
	G		A	A	A	
8. Waist Circumference	M	83.46	82.46	87.14	85.59	1.28
	G		A	A	A	
9. Hip Circumference	M	104.51	104.11	105.03	106.14	0.48
	G		A	A	A	
10. Ruler A	M	5.86	5.47	4.38	8.96	78.86***
	G		B	C	A	
11. Ruler B	M	6.85	5.98	8.86	9.60	113.58***
	G		C	B	A	
12. Ruler C	M	17.99	17.35	17.29	15.66	12.16***
	G		A	A	B	
13. Horizontal of Shoulder	M	32.71	19.93	47.73	85.00	81.99***
	G		C	B	A	
14. Angle α	M	19.92	18.11	14.59	33.09	120.96***
	G		B	C	A	
15. Angle β	M	23.34	19.91	29.41	35.77	159.42***
	G		C	B	A	

* $p \leq .05$ ** $p \leq .01$ *** $p \leq .001$

Alphabets were results of Duncan grouping (A>B>C)

of the factor analysis indicated that 5 factors can be extracted in Korean and 4 factors can be extracted in the U. S. women from 15 body measurements to explain the variance.

The results of cluster analysis by shoulder slope angle and forward displacement of the shoulder of Korean and the U. S. classified them in three groups, cluster 1, cluster 2 and cluster 3

respectively. Based on these results, differences exist both among and between Korean and U.S. body characteristics for older women, especially in the shoulder area. In the present study, the Korean data was restricted to the subjects of the certain region in Korea.. Therefore, further studies to obtain the data of the body measurement from wider regional subjects in Korea according to the age group are required.

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Received 29 October, Accepted 30 November.